



Enhancing zebu production in Madagascar through optimal nutrition and sustainable exploitation of grassy ecosystems surrounding biodiverse forests

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Abstract

Madagascar's poverty is partly linked to inadequate livestock nutrition and inefficient use of grassland, which covers more than half of the country's surface. Prioritising zebu nutrition and efficient use of native forage species can lead to substantial improvements.

This project involves 90 households and is working to improve zebu breeding around three protected forests in Madagascar: Ankafoabe, Ibity and Itremo. The initiative focuses on pasture productivity, forage grass management and livestock nutrition. It includes demonstration farms, experimental pastures and forest plots with a fire management plan. Monitoring focuses on cow performance, forage production, grazing capacity and biomass productivity.

Across the project sites, nitrogen deficiency and low phosphorus and potassium levels are common. The successful silage production (1881 kg/ha) resulted from combining Supergraze 1000 forage sorghum with legumes in Ibity. Households fed zebus with silage and hay for the first time. In Ibity, milk production tripled, while in Itremo and Ankafoabe, beneficiaries focused on calf production, achieving annual calving rates of 63.4% and 58.0%, respectively. Initially, 123 grass species were inventoried around experimental pastures. After fire and grazing, grazing capacity decreased from 1.4 ha to 0.7 ha/zebu/year, and biomass production varies between 300 and 800 kg/ha.

Madagascar remains famous for subsistence farming with long-term decline in livestock, but there are significant opportunities for integrated crop-livestock production and the sustainable use of grassland while preserving biodiversity.

Introduction

In Madagascar, grasslands are vital to the rural economy, especially for livestock farmers who rely on native forage grasses to feed their animals (Bossier 1969; Randrianarimanana et al. 2024). However, these pastures face significant challenges. Annual bush fires, often set to renew pastures, disrupt local ecosystems, threaten

biodiversity, and degrade soils (Kull 2002). Additionally, population growth increases pressure on the remaining land and forage quality, heightening the demand for natural resources (WorldData.info February 2025). It is increasingly important to balance the interests of local communities with biodiversity conservation by adopting sustainable natural resource practices. Innovative solutions for managing native forage grasses and improving animal husbandry practices, particularly in feeding, could help balance animal production with the preservation of protected areas (Kew 2021). This study aims to propose solutions to enhance zebu nutrition by leveraging botanical knowledge, agricultural science, and fire management expertise.

Methods

The project collaborates with local communities living around three protected areas in Madagascar's central highlands: Ankafobe, Ibity, and Itremo. These communities have built trusting relationships with international researchers for over two decades. The project operates on the principle that farmers learn best by applying techniques observed at demonstration sites, ensuring the effective transmission of methods tailored to local conditions.

- The project is collaborating with 30 Malagasy zebu-owning households to initiate pilot activities in their villages.
- A demonstration farm per site has been established with 4 female zebus to monitor milk production, body condition, calving rates, grazing effects in the experimental pasture, and other farm activities.
- A demo barn was constructed at each site using a simple, replicable model with locally available materials.
- The project includes 2 hectares of fenced experimental pasture: 1 hectare protected from fire and 1 hectare burned, to compare grass species diversity, frequency, biomass production, and grazing management using the project zebus.
- Additionally, a one-hectare field has been set up for planting other forage crops, such as Sorghum sp., for silage production, combined with leguminous crops.
- The project also utilizes available crop residues for storage and use during the dry period.

Results

As the project aimed to enhance zebu nutrition through new techniques, the following metrics were recorded: fodder production, animal production from zebu breeding on the demonstration farm and among beneficiary farmers, including milk production, zebu body condition scores, and annual calving rates.

Forage production

The project and beneficiary households produced 770 kg/ha of Supergraze 1000 (SS1000) sorghum silage and 2704 kg of native grass hay during the last year of the project. The main crop residues used are peanut, bean and corn stalks, urea-treated rice straw to feed zebu, and sweet potato stalks to improve silage quality.

The following photos show the research activities carried out in each experimental pasture, including inventories and monitoring of the frequency and diversity of native grass species, and the rotational grazing method

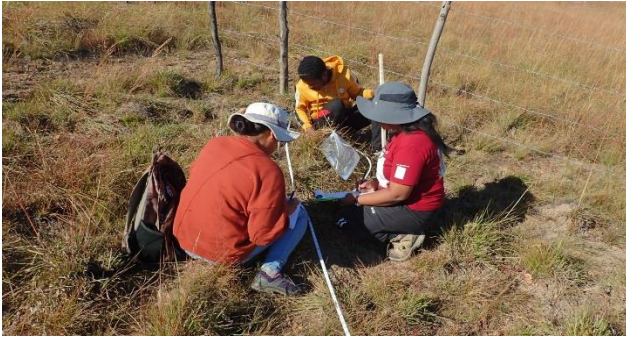


Figure 1: Inventory of grass species in the experimental pasture



Figure 2: Rotational grazing with project zebras on experimental grazing land

For the pasture biodiversity, 133 species from 31 families and 95 genera including grass and forb dominated by *Poaceae*, *Asteraceae*, *Cyperaceae*, *Fabaceae*, *Orchidaceae*, *Rubiaceae*. Pasture quality annual biomass production is about 2,700-8,356 kg/ha depending on the fire regimes. The average biomass productivity for the 3 sites during the project is as follows:

- For unburned pasture: 2850 kg/ha in year 1 (2022), 4418 kg/ha in year 2 (2023) and 9765 kg/ha in year 3 (2024).
- For burnt pasture: 3851 kg in year 1, 2981 kg/ha in year 2 and 4985 kg/ha in year 3.

The average species per plot region is about 9 -13 for Ankafobe, 8 - 13 for Ibity and 3 - 6 for Itremo in 2024. In terms of soil quality, across all sites, the soil analysis exhibit very low levels of nitrogen, phosphorus, potassium, and calcium. Additionally, all sites show high iron toxicity, with Ankafobe being particularly affected.

Zebu production

Figure 3 illustrates the changes in calving rates for both beneficiary and project zebras over the three years of project implementation, compared to the baseline.

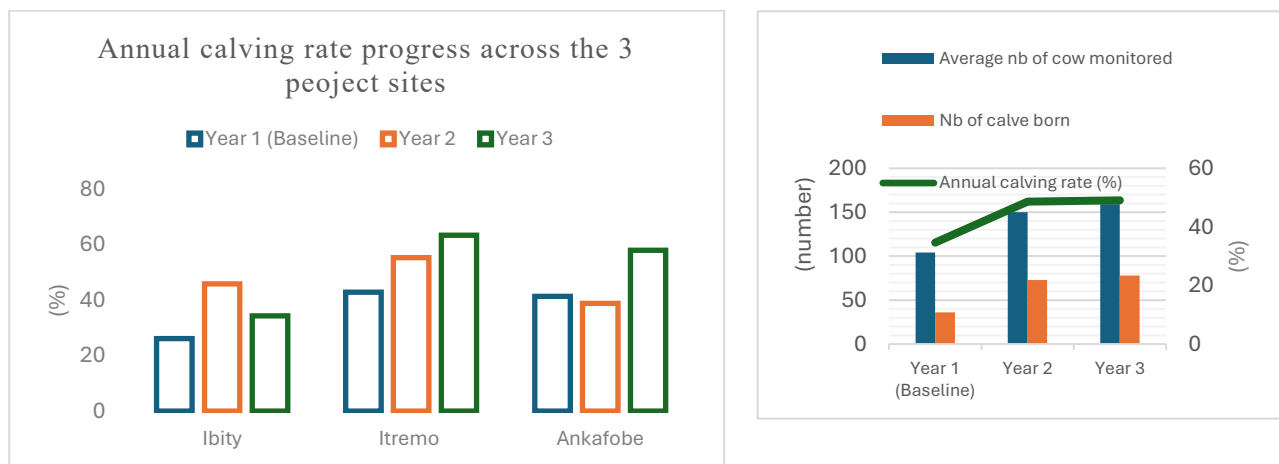


Figure 3: Change in percentage zebu calving rate over 3 project years compared with the pre-project baseline level, number of cows monitored, and number of calves born.

Beneficiaries in Ankafobe and Itremo had higher calving rates than those in Ibity, indicating a preference for more calves over milk production (Figure 4). This suggests that weaning around two months after calving encourages zebu to prepare for the next reproductive cycle.

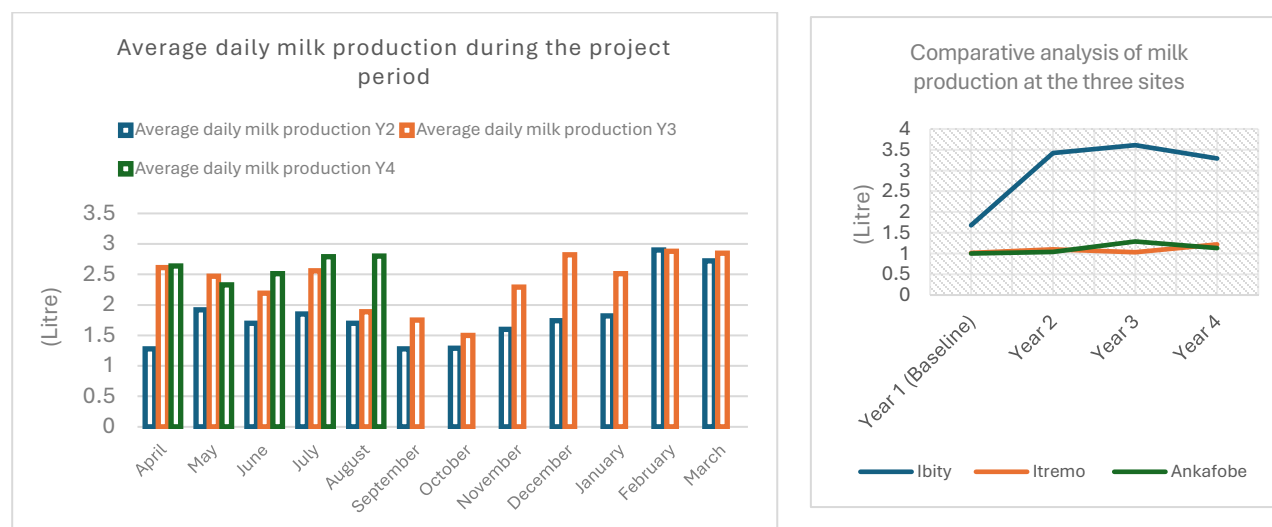


Figure 4: Average daily milk production over the 3 years of the project compared with the pre-project baseline level.

Farmers are gaining experience each year (Figure 4). Despite only having data for the first four months of year 4 (end of the project), it is evident that farmers have mastered feed stock management, ensuring sufficient feed for the dry period.

Discussion

Reducing rural poverty in Madagascar through the development of cattle farming, particularly in terms of feed, is entirely achievable. Effective pasture management using native grasses, through conservation techniques like haymaking and controlled grazing fire management, are among the best strategies, despite their challenges. In Madagascar, the focus should be on improving extensive grazing land, which is still in a legal vacuum: it is neither officially untitled property, nor land with a defined legal status (Ranjatson P et al 2021). Additionally, utilizing available resources such as crop residues to ensure consistent feeding during dry periods is beneficial. Incorporating high-nutrient, climate-tolerant, soil-covering forage species like sorghum is also highly recommended to quickly address feed deficits in native grasses. To improve soil quality, it is crucial to educate farmers on using zebu manure to create compost for their crops, as well as employing crop rotation and association techniques to alleviate land requirements, cover the soil, and increase yields for both food and feed on the same field. Decreasing the frequency of fires will reduce soil sensitivity to heavy rainfall, thereby minimizing the risks of erosion and soil degradation (Masse et al 1997, Louppe D 2004). The degraded soil quality negatively impacts the floristic and nutritional composition of the pastures, likely leading to soil erosion. The forage grasses that grow in these conditions are also expected to have low nutritional value (Rasambainarivo 1997).

Integrating zebu breeding into farming practices will further facilitate this approach. These new practices for the community will also contribute to the protection of biodiversity around protected areas.

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